Similar Image Retrieval for Trochanteric Fracture Using Convolutional Neural Networks

Kentarou Kaneko, Mitsuaki Noda, and Ryo Ohtera

Abstract— **This study validates the effectiveness of a deep learning method to determine the similarity between instances of femoral trochanteric fractures. Furthermore, our findings highlight the extraction of features corresponding to the fracture instances from plain X-ray images of femoral trochanteric fractures. In this study, we focus on a coarse classification of fracture types using extracted feature vectors.**

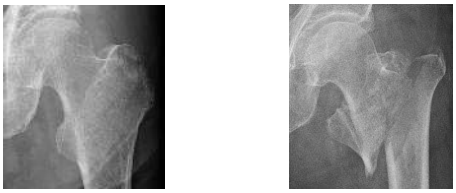
I. INTRODUCTION

This study aims to verify the potential advantages of employing deep learning to search for similar instances of femoral trochanteric fractures.

For the imaging diagnosis of femoral trochanteric fractures, a plain X-ray system is first used to confirm the diagnosis. Then, in cases where diagnosis from X-ray images is difficult, additional imaging examinations are required using computed tomography (CT) equipment. However, many countries face the problem of accessing advanced medical equipment such as CT, and improving the diagnostic accuracy from plain X-ray images is required as a social issue. In order to solve this issue, we propose a system that searches a past X-ray image similar to the unknown input X-ray image and presents linked CT images. However, the focus of this paper is to establish a method for similarity determination among X-ray images using deep learning as a preliminary step.

II. PROPOSED METHOD

When a fracture occurs due to a strong external force on the femoral intertrochanteric area, the visual features appear on the femoral trochanteric area. To obtain feature vectors from plain X-ray images and to calculate the similarity between the images, we use the "EfficientNetV2M[1]" trained model from the ImageNet dataset. The Global Average Pooling (GAP) is added to extract feature vectors on the output layer side of the inference model. Then, cosine similarity is used as a measure of similarity between the query image and the retrieved image, and the similarity between feature vectors is calculated. In this study, X-ray images from 25 patients are used as query and search images. These images include instances of 15 stable fracture-type images and 10 unstable fracture-type images. Figure 1 shows the examples of X-ray images of each type. In the case of stable trochanteric fractures, the lateral wall remains thicker to support a long fragment. On the other hand, in the case of unstable trochanteric fractures, the lateral wall becomes thinner.



(a) (b)

Figure 1. Examples of X-ray images *(a.Stabele type /b.Unstable type)*

III. RESULTS

To evaluate the accuracy of the constructed feature extractor, it was verified whether the top-ranked image belonged to the same type of fracture as the query image.

Table 1 shows the probability that the query image and the images identified as similar to the query image had the same type of fracture.

TABLE I. ACCURACY OF THE IMAGE RETRIEVAL

Stable type	Unstable type
67%	70%

The results showed that 67% were correct for stable case images and 70% were correct for unstable case images. These results substantiate the potential of deep learning as an effective similarity retrieval method for instance of femoral trochanteric fracture. However, the proposed method was insufficient in its ability to select the most similar image.

IV. CONCLUSIONS

Our study showed the possibility of accurately extracting features in plain X-ray images of femoral trochanteric fractures and identifying similarities in plain X-ray images with the same fracture type. In the future, our focus will shift to the task of constructing a system that retrieves similar past case plain X-ray images from unknown case plain X-ray images and presents CT images linked to them. This pursuit has great potential to improve the diagnostic process of femoral trochanteric fractures and thereby advance the post-operative quality of life of patients by enabling appropriate medical treatment.

REFERENCES

[1] M. Tan and Q. V. Le, "EfficientNetV2: Smaller Models and Faster Training," arXiv preprint arXiv:2104.00298, 2021, Available: https://arxiv.org/pdf/2104.00298.pdf.

*Kentarou Kaneko is with the Kobe Institute of Computing, Graduate School of Information Technology (phone:+81-070-2838-2549; e-mail: s22030@st.kic.ac.jp).

Mitsuaki Noda is with the Nishi Hospital (e-mail:m-noda@muf.biglobe.ne.jp).

Ryo Ohtera is with the Kobe Institute of Computing, Graduate School of Information Technology (e-mail:ryotera@kic.ac.jp).